

CLAY MASONRY FAMILY FALLOUT SHELTERS

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CONTENTS

| | Page |
|--|------|
| Introduction..... | 3 |
| Basement Shelter, Existing Construction..... | 4 |
| Basement Shelter, New Construction..... | 5 |
| Underground Shelter..... | 6 |
| Aboveground Shelter..... | 6 |
| Blast and Fallout Shelter, Aboveground..... | 6 |
| Appendix..... | 8 |

DEFINITIONS

Radioactive fallout is particles of earth and debris drawn up into the fireball and resulting mushroom shaped cloud of a nuclear explosion which become radioactively contaminated, and later fall back to earth.

Radioactivity is the emission of radiant energy, alpha, beta, and gamma rays, by the disintegration of the nuclei of atoms.

Shielding—There are two methods of shielding from fallout radiation: *barrier shielding* and *geometry shielding*.

Barrier shielding is the placing of a mass between the fallout field and the individual. The heavier the protective barrier, the greater the barrier shielding effect.¹

Geometry shielding is determined by the extent of the fallout field affecting an individual, and/or his distance from it.²

Mass thickness is the weight per unit surface area of a barrier, usually expressed in pounds per square foot. See Table II, which indicates commercially available wall thicknesses for equivalent mass thicknesses of several materials.

Protection factor—The combined effects of barrier shielding and geometry shielding result in a shelter “protection factor”. This term is used by technicians to express the relative reduction in the amount of radiation that would be received by a person in a protected location, compared to the amount he would receive if he were unprotected. For example if a shelter has a protection factor of 500, an unprotected person would be exposed to 500 times more radiation than someone inside the shelter.

Wythe—Each continuous vertical 4 inches or greater section of thickness of masonry.

Overpressure—For nuclear blast design, the first important decision that must be made is the level of blast pressure that is to be resisted by the structure. This pressure is spoken of as “overpressure”, or the excess of pressure over normal atmospheric pressure due to the passage of the shock front.

Reflected pressure—When the blast wave strikes a surface, such as that of a structure, a reflected pressure results which can be more than twice the value of the peak overpressure.

¹“Fallout Shelter Surveys: Guide for Executives,” Office of Civil and Defense Mobilization, October 1959.

²Ibid.

INTRODUCTION

Radioactive fallout respects no person and no place. There is not a home in America that could not be affected by fallout after a nuclear attack. Shelter from fallout is the greatest single protection for you and your family.

The Office of Civil and Defense Mobilization published last year "The Family Fallout Shelter" booklet MP 15. That publication contains plans for five basic fallout shelters.

The Structural Clay Products Institute of Washington, D. C., has prepared the booklet "Clay Masonry Family Fallout Shelters" in order to provide the public with five additional plans for basic fallout shelters which can be built in or near your home. OCDM technical officers have reviewed and found that it meets OCDM standards for effective shelter.

Each of these shelters provides protection from fallout radiation of a nuclear bomb. They also can protect your family against natural disasters such as hurricanes and tornadoes.

This booklet demonstrates again that there **are** means of protection against fallout—if you do something about it before disaster strikes.

LEO A. HOEGH

Director

Office of Civil and Defense Mobilization

UNDERGROUND SHELTER

An underground clay masonry fallout shelter can be built by a contractor for about \$800 to \$1,200, depending upon the entrance used. Figure 7 is the line drawing for this shelter. The shelter will provide excellent fallout protection. It has a protection factor of 1,000 or more on the basis of OCDM criteria.

The line drawing (fig. 7) shows the shelter with earth mounded over the roof. This shelter can be built into an embankment or entirely below grade.

This shelter also provides excellent protection against hurricanes and tornadoes, and can easily be made blast resistant by providing a blast-resistant door at the entrance. It already has some inherent blast resistance (approximately 5 - 7 psi blast overpressure). It may be necessary, however, to provide greater stability depending upon the design overpressure. If a blast shelter is desired, it is recommended that a competent engineer be employed.

ABOVEGROUND SHELTER

An outdoor aboveground fallout shelter can be built of clay masonry units. Most generally this type of shelter is built in regions where water or rock is close to the earth's surface making it impractical to build underground.

The exterior walls of this shelter are constructed of two wythes of brick, 1-foot, 8-inches apart. The space between the brick is filled with compacted pit-run sand or gravel. The two brick wythes are tied together with non-corrosive metal ties as indicated on the line drawing shown as figure 8.

The roof is a 6-inch reinforced concrete slab, having a brick parapet wall. Upon this slab is placed two coats of hot asphalt waterproofing, then 16 to 20 inches of pit-run sand or gravel fill.

This shelter will provide exceptionally good protection against fallout at a cost of about \$900 to \$1,250. This shelter has a protection factor of 250 to 1,000, based on OCDM criteria.

BLAST AND FALLOUT SHELTER ABOVEGROUND

Reinforced Brick Masonry (RBM) is employed in making the family shelter shown as figure 9 resistant to blast as well as fallout. This aboveground shelter provides excellent protection against the ravages of hurricanes and tornadoes in addition to its radiation shielding. Most generally this type of shelter is built in regions where water or rock is close to the earth's surface, making it impractical to build underground.

A family in this shelter would be protected from a nuclear explosion of 20-megaton size as close as 5 miles from ground zero. The radiation protection factor of this shelter is approximately 600 - 700, based on OCDM criteria.

The exterior walls of the shelter are constructed of two walls of brick masonry, 1 foot apart. One wall is a 10-inch RBM wall and the other is 4 inches of brick tied to the RBM wall with non-corrosive metal ties spaced as indicated on the drawing (fig. 9). The space between the brick is filled with compacted pit-run sand or gravel.

The roof is a 10-inch slab of reinforced concrete upon which is poured 10 more inches of fill concrete, making a total roof thickness of 20 inches. The door is blast resistant and heat reflective, able to withstand a blast overpressure of approximately 10 pounds per square inch.

Blast and fallout protection is provided by this shelter at a cost of approximately \$1,200 to \$1,700 dollars.

Figure 2

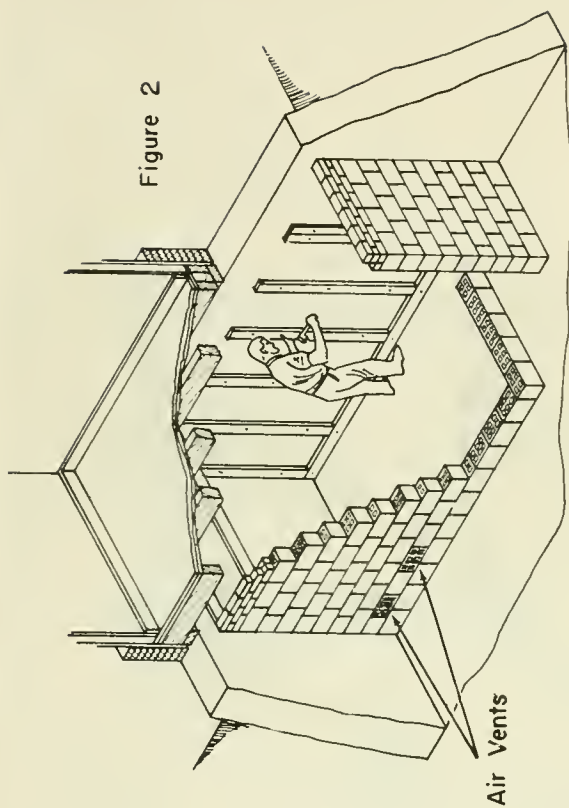


Figure 4

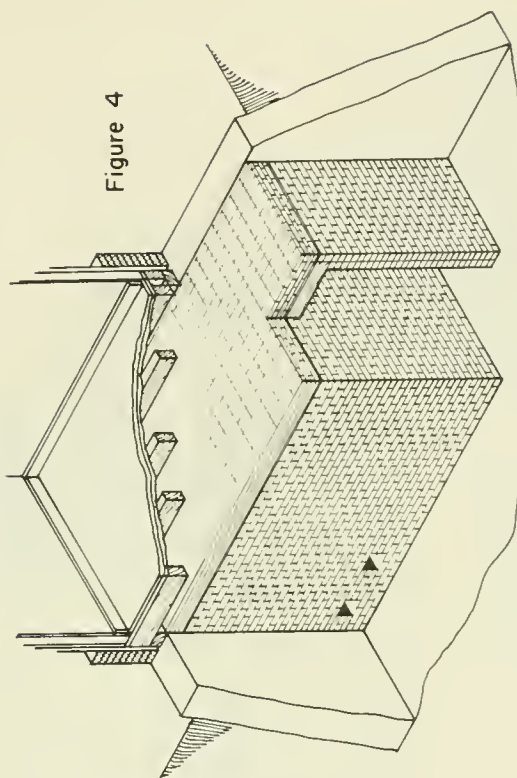


Figure 1

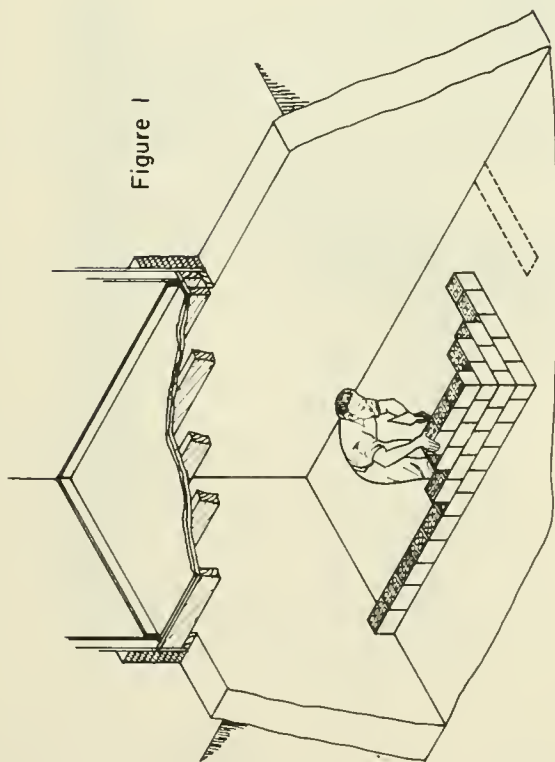
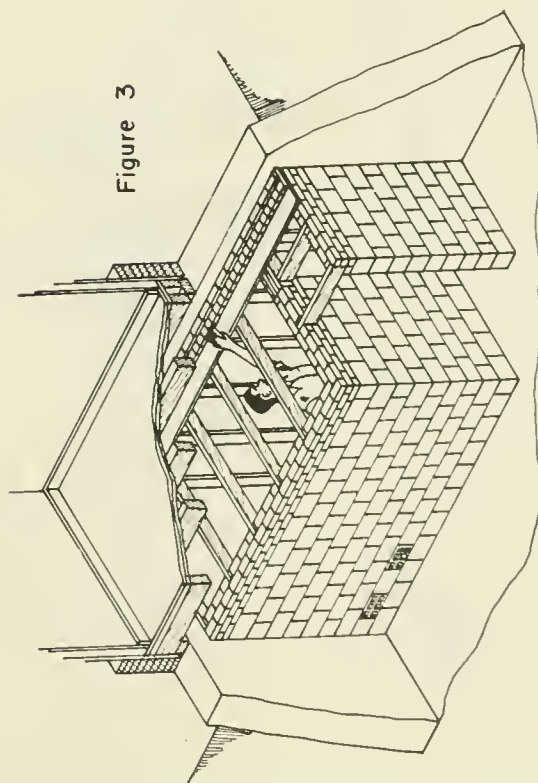


Figure 3



APPENDIX

CONTENTS

| | Page |
|---|------|
| Fig. 5—Basement Shelter, Existing Construction | 9 |
| Fig. 6—Basement Shelter, New Construction | 10 |
| Fig. 7—Underground Shelter | 11 |
| Fig. 8—Aboveground Shelter | 12 |
| Fig. 9—Blast and Fallout Shelter, Aboveground | 13 |
| Table I—Radiation protection factors | 14 |
| Table II—Equivalent mass thicknesses | 14 |
| Table III—Relation of overpressure to distances from ground zero | 15 |
| Table IV—Description of shelter protection categories | 15 |
| Table V—Tools required for building Basement Shelter, Existing Construction | 16 |
| Table VI—Materials required for building Basement Shelter, Ex- isting Construction | 16 |

Note: Larger scale drawings of figures 5, 6, 7, 8, and 9 may be obtained through your local civil defense organization, or from OCDM, Battle Creek, Michigan. It is important that drawings be ordered by "Figure Number" and that reference be made to this publication, MP-18.



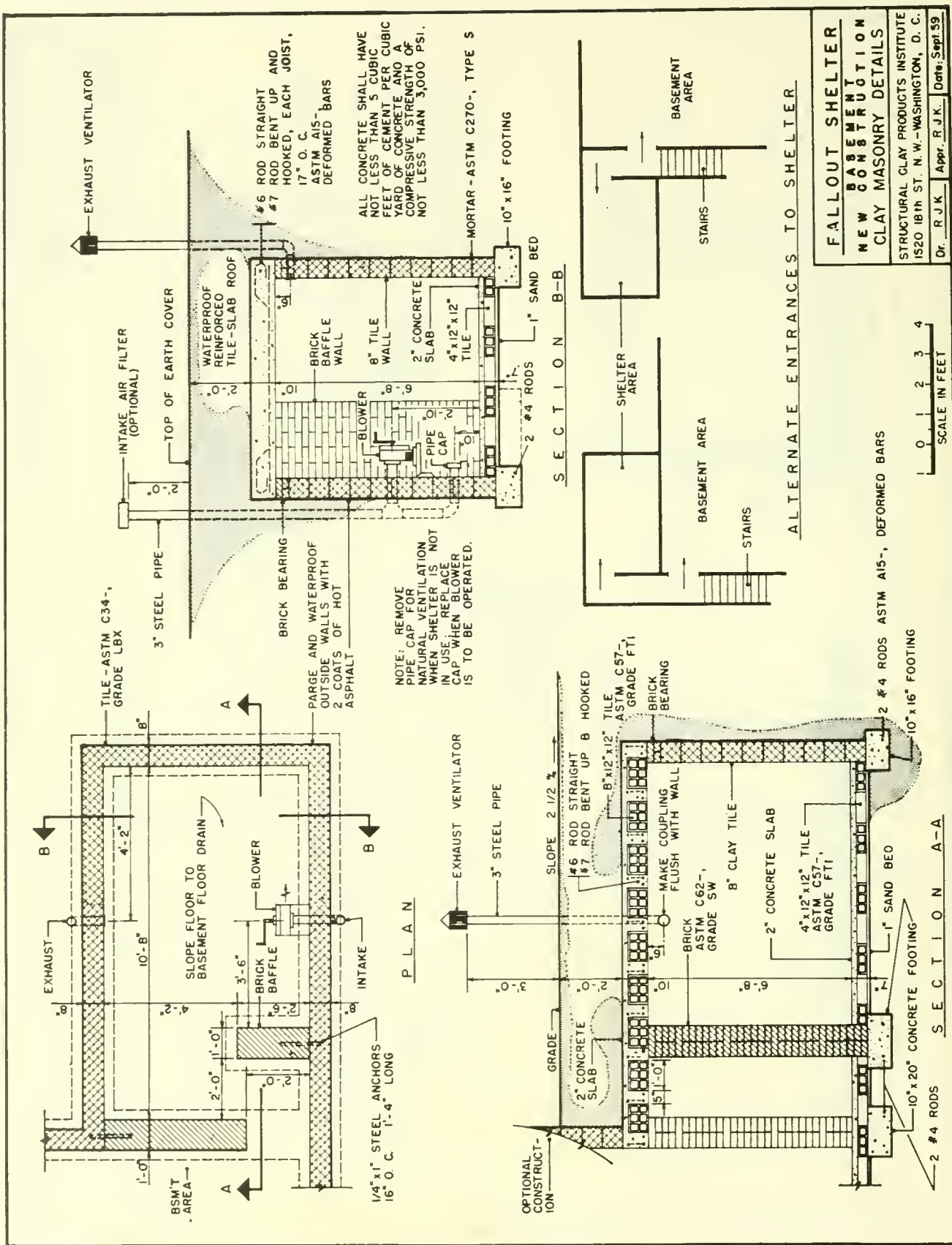


Figure 6

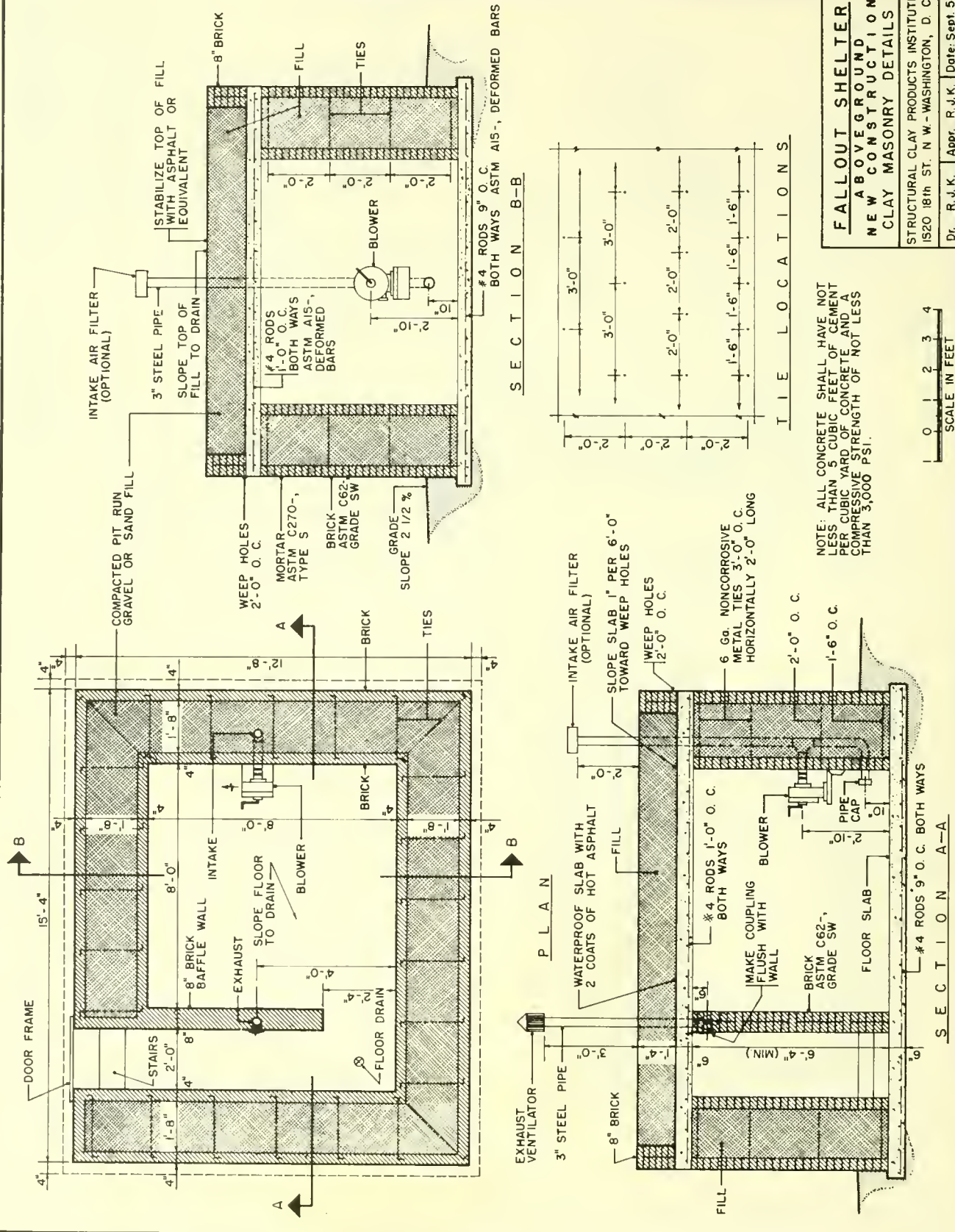


Figure 8

TABLE I.—Radiation Protection Factors
(For Small Aboveground Shelters)

| | | Roof Mass Thickness, psf | | | | | |
|--------------------------|-----|--------------------------|-----|-----|------|------|-------------------|
| | | 100 | 150 | 200 | 250 | 300 | 400 |
| Wall Mass Thickness, psf | 100 | 12 | 15 | 15 | 15 | 15 | 15 |
| | 150 | 25 | 40 | 45 | 50 | 50 | 50 |
| | 200 | 40 | 85 | 115 | 140 | 145 | 150 |
| | 250 | 50 | 130 | 230 | 335 | 385 | 415 |
| | 300 | 55 | 160 | 345 | 670 | 910 | 1110 |
| | 400 | 55 | 165 | 500 | 1670 | 5000 | Greater than 5000 |

TABLE II.—Equivalent Mass Thicknesses (lb./sq. ft.)

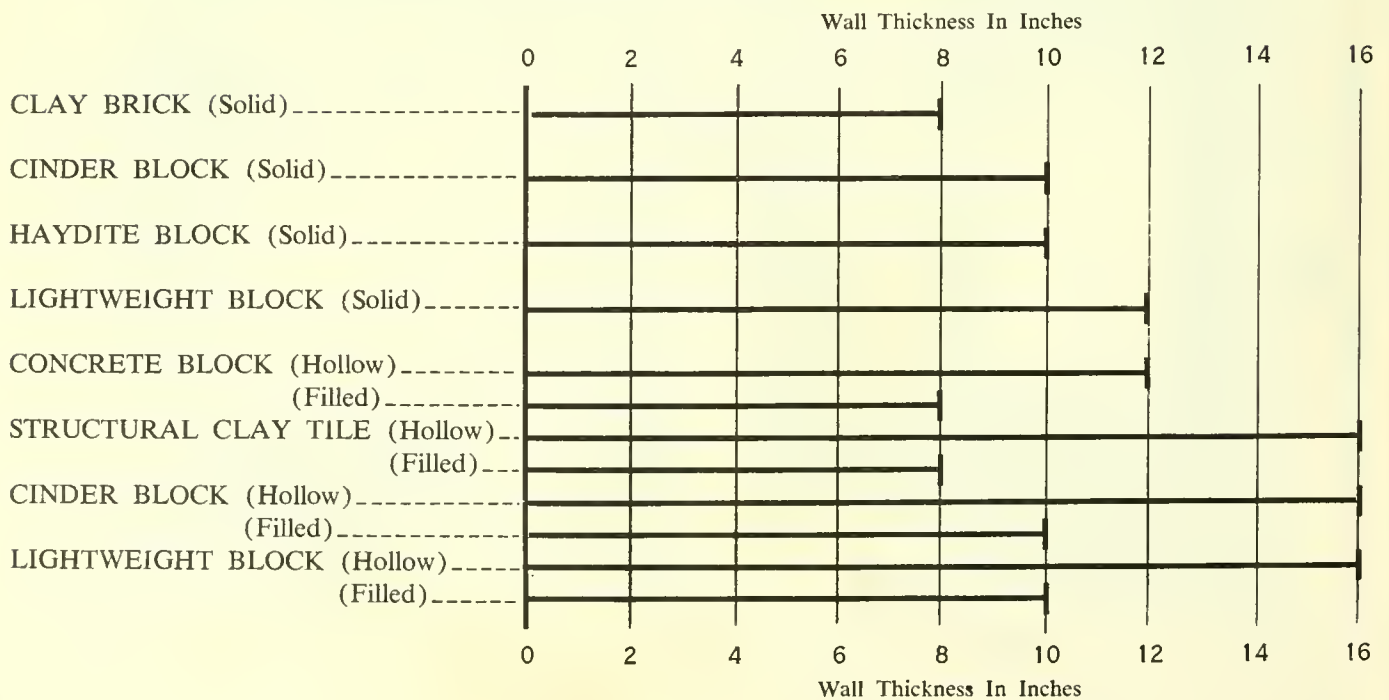


TABLE III.—Relation of Overpressure to Distances From Ground Zero*
(For a Typical Surface Blast)

| Overpressure (psi) | Distance From Ground Zero | |
|-----------------------|---------------------------|------------------------|
| | 20 kilotons (atomic) | 20 megatons (hydrogen) |
| 40 | 1,500 ft. or 0.38 mi. | 15,000 ft. or 2.8 mi. |
| 20 | 1,900 ft. or 0.36 mi. | 19,000 ft. or 3.6 mi. |
| 10 | 2,700 ft. or 0.51 mi. | 27,000 ft. or 5.1 mi. |
| 5 | 4,000 ft. or 0.76 mi. | 40,000 ft. or 7.6 mi. |
| 2 | 8,000 ft. or 1.52 mi. | 80,000 ft. or 15.2 mi. |

* "The Effects of Nuclear Weapons"—U. S. Dept. of Defense, 1957
Fig. 3.94a, page 109.

TABLE IV.—Description of Shelter Protection Categories*

| Protection factor | Shelter examples |
|-------------------|--|
| 1,000 or greater. | OCDM underground shelters. Subbasements of multistory buildings. Underground installations (mines, tunnels, etc.) |
| 250 to 1,000. | OCDM basement fallout shelters (heavy masonry residences). Basements (without exposed walls) of multistory buildings. |
| 50 to 250. | OCDM basement fallout shelters (frame and brick veneer residences). Central areas of basements (with partially exposed walls) of multistory buildings. Central areas of upper floors (excluding top floor) of large multistory buildings with heavy exterior walls and floors. |
| 10 to 50. | Basements (without exposed walls) of small 1- or 2-story buildings. Central areas of upper floors (excluding top floor) of large multistory buildings with light exterior walls and floors. |
| 2 to 10. | Basements (partially exposed) of small 1- or 2-story buildings. Central areas on ground floors in 1- or 2-story buildings with heavy masonry walls. |
| Less than 2. | Aboveground areas of low buildings, in general, including residences, stores, light industrial buildings. |

* Based on current OCDM criteria.

TABLE V.—Tools Required for Building Basement Shelter, Existing Construction. (See fig. 5.)

| ITEM | CHECK |
|--|-------|
| Mixing pan for mortar | |
| Measuring pail for sand and cement | |
| Hoe for mixing mortar | |
| Hose or water can | |
| Mason's trowel (8" or 10") | |
| Mortar board | |
| Mason's level | |
| Mason's hammer | |
| Folding rule (6 ft.) | |
| Stringline and line blocks | |
| Chalkline, pencil | |
| Crosscut saw | |
| Claw hammer | |
| Carpenter's square | |
| Wrench (crescent) | |
| Drill, masonry bit, 5/8", 5" long wood bit, 5/8", 4" long | |

TABLE VI.—Materials Required for Building Basement Shelter, Existing Construction. (See fig. 5.)

| ITEM | AMOUNT |
|--------------------------------------|---------------|
| 2-2/3" x 4" x 8" brick | 2250 |
| 8" x 8" x 12" structural clay tile | 205 |
| 2" x 6" structural grade lumber | 35 lineal ft. |
| 2" x 4" structural grade lumber | 87 lineal ft. |
| 1" x 8" (or 1" x 12") wood sheathing | 88 board ft. |
| 1/2" x 6" steel bolts | 30 |
| 16 d nails, 8 d nails | 1 lb. each |
| sand | 60 cu. ft. |
| cement | 2 cu. ft. |
| lime (or lime putty) | 2 cu. ft. |